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## 23. To the Upper Lake: Star Carr revisited – by birchbark canoe

Peter Rowley-Conwy

### Introduction

Tony Legge instigated the re-analysis of the animal bones from Star Carr that led to our joint volume (Legge and Rowley-Conwy 1988). I worked as his post-doc on the Tell Abu Hureyra project, in which we had been developing methods such as tooth eruption and bone growth to look at seasonality. Tony had always felt that a re-analysis of the Star Carr fauna, using these methods, would be a worthwhile project, and I well remember the day in 1983 when we went to ask Grahame Clark if he had any objection to our revisiting the bones. “Oh no, that’s all history now,” was Clark’s response. So we got to work.

We concluded that Star Carr was occupied in late spring and early summer, not winter and early spring as had been previously believed. We also argued, on the basis of skeletal element frequencies, that Star Carr was a logistic site, not a residential location; specifically, that it was a hunting camp from which meat had been removed and taken away for consumption elsewhere.

Two major developments have taken place over the last three decades. First, many more sites have been located around the prehistoric Lake Flixton. The Seamer Carr Project excavated a series of sites at Seamer Carr (Schadla-Hall 1987, 1989), and the Vale of Pickering Research Trust has examined the rest of the lake shore (summarised in Milner *et al.* 2011). Fig. 23.1 (top) plots the sites as now known. None of these sites is a ‘new Star Carr’; all have produced much smaller collections of material including some faunal remains. This has been accompanied by detailed ecological surveys of the lake-edge itself (Cloutman 1988a and b, Cloutman and Smith 1988, Taylor 2011). Second, the Star Carr site itself has been shown to be larger than Clark envisaged, encompassing several areas of activity (Mellars and Dark 1998), including a considerable spread of split timbers and a dwelling structure (Conneller *et al.* 2012). These developments allow Star Carr to be viewed in its local context.

### **FIGURE 23.1 HERE**

In this contribution I will explore some aspects arising from this. I will argue for a new model of hunter-gatherer subsistence and settlement in Preboreal northeastern England – based on the central importance of the birchbark canoe.

### Logistic hunter-gatherers at Lake Flixton

The argument that Star Carr was a logistic hunting camp was based on skeletal element frequency, which suggested that the meatier parts of the animals had been removed. For red deer, this involved the haunch: pelvis, femur, and proximal tibia. For the aurochs, the heavily muscled forequarters were removed along with the haunch (Legge and Rowley-Conwy 1988, 87-91) (see Fig. 23.2 top). Although some of these bones are relatively soft and can be destroyed, we argued that preservation conditions were good, and that dog gnawing was minimal, so these factors could not be blamed for the pattern (*op. cit.*, 69-74). Bone grease or bone fat manufacture might also cause element destruction, but the recent excavation of a bone grease

manufacturing feature involving bison bone indicates that the process would generate very large numbers of diaphyseal splinters, the majority below some 5 cm in length (Karr *et al.* 2015). Some discard of bone fragments certainly occurred during Clark's excavation (Elliott and Milner 2010, 83), but if large numbers of fragments had been present it is unlikely that this would have escaped notice. The later excavations both at Star Carr and elsewhere in the Vale have not produced very large numbers of such fragments. Bone grease manufacture is thus probably not the cause of the pattern.

#### **FIGURE 23.2 HERE**

Support for the difference between the treatment of red deer and aurochs comes from the differential treatment of caribou and bison in North America (discussed in Legge and Rowley-Conwy 1988, 87-91). Analogous patterns in deer bone frequencies have been found, and similar logistic arguments put forward, at both Arruda in Portugal (Rowley-Conwy 2015) and Awashimadai 1989 in Japan (Uchiyama 2015). Both these latter sites can be approached by water.

A group of bones from Seamer Carr site B adds to this. These comprise the articulated pelvis and lumbar vertebrae of an aurochs, with other bones closely associated: a right mandible and maxilla, a hyoid, a proximal right radius, four thoracic vertebrae, 15 rib fragments and the left and right pelvis. These were associated with a scatter of flint artefacts and all probably come from one single aurochs (Uchiyama *et al.* in press). The bones are plotted in Fig. 23.2 (lower). These bones may represent the butchery of an aurochs in preparation for meat transport, because the pattern is similar to that at Star Carr except for the radius and the pelvis. Other sites argued to be aurochs butchery locations include Potsdam-Schlaatz, where all the vertebrae remained but the pelvis was absent (Gustavs 1987), and Balkweg, where only the vertebrae and the extremities remained (Prummel and Niekus 2011). Removal of the meaty elements of both fore- and hindlimbs is common to all these three butchery sites.

If the above is correct, substantial quantities of meat were exported from Star Carr and Seamer Carr. The most practical means of doing this would be by canoe, because both the distance travelled and the weight carried can be dramatically increased (Ames 2002). Two aspects of the location of Star Carr support this. First, the site is by the outflow of the Hertford River from Lake Flixton. Second, Star Carr was placed with immediate access to relatively deep water close inshore, where the reed belt was at its narrowest (Fig. 23.1). Even a relatively narrow reed zone presents an impenetrable barrier to a canoeist seeking to land (Fig. 23.3). Easy canoe access to open water is thus argued to be the single crucial factor determining the location of Star Carr.

#### **FIGURE 23.3 HERE**

As Cloutman (1988a, 17) notes, Walker and Godwin (1954) established the presence of relatively deep water close to Star Carr. Cloutman himself confirmed this in detail, identifying “an open-water inlet” at Star Carr (1988a, 18). Only a few metres to the east, in the area of the 1985 excavation, the reedswamp zone was broader (op. cit., 17), emphasising the local nature of the inlet. Further north towards Seamer Carr the reedswamp was broader (Cloutman 1988b); the conclusion is that “[Star Carr] was chosen for its shelter and easy access to the lake. At no other place in the immediate area did the open water so closely approach the shore” (Cloutman and Smith 1988, 55).

Fig. 23.1 (bottom) is a tentative reconstruction of the western end of Lake Flixton during the period of occupation, based on Cloutman's work. Precise delineation of the shoreline is problematic, and in any case this presumably changed

somewhat through time. The 23 m contour marks the shoreward edge of calcareous mud in the basin (Cloutman 1988, 6), and the lake level would have been at or above this level (op. cit., 17). Organic muds reached up to 24.5 m, and this is likely the maximum water level (op. cit., 17 and fig. 13). Lake level was thus between 23 and 24.5 m, and this zone contains many remains of *Phragmites* reeds. This zone is therefore suggested to be the main reed swamp in Fig. 23.1, except in the shallow embayment towards Seamer Carr. In this region fen carr vegetation was already advancing towards the centre of Lake Flixton (Cloutman 1988b). The edge of the reed swamp here is taken from Schadla-Hall (in Spratt 1993, fig. 26) and marked by the dotted line in Fig. 23.1.

The tentative nature of this reconstruction must be stressed, and the reed swamp zone would have changed through time. But Fig. 23.1 (bottom) shows that deep-water access was better at Star Carr than in most other locations, supporting the importance of canoes. From this perspective, various other lines of evidence may be examined. Clark's (1954) "brushwood platform" is now generally regarded as a natural accumulation (Coles and Orme 1983). However, a definite platform made of split planks was excavated in 1985-89 (Mellars *et al.* 1998), and recent work suggests that it may extend as far as the edge of Clark's original excavation (Conneller *et al.* 2012). This major stabilisation of the lake edge can be interpreted as a canoe landing stage.

Repeated but localised burning has been detected in two pollen diagrams from Star Carr (Dark 1998a and b), and from No Name Hill and Flixton School Field (Cummins 2000). These are marked in Fig. 23.1 (top). The reed belt was what was being burnt: Hather (1998) identified numerous charcoal fragments of *Phragmites australis*, the common reed. Reasons advanced to account for this include increasing visibility across the lake (Mellars and Dark 1998, 212); increasing fodder availability to attract grazing mammals (Day 1993, 132; Mellars 1998, 230-2); unspecified management practices (Taylor 2011, 68); accident (Day 1993, 132); and improved access to open water (Innes *et al.* 2011, 94).

Most of these reasons are rather unlikely. Visibility would be enhanced only directly to the south, because of the higher ground immediately east and west (Cloutman and Smith 1988, 55). The inhabitants could have gained a much wider view by walking up the 27 metre rise adjacent to the site (Fig. 23.1 bottom), which would raise them above the height of the reedswamp. Attracting game animals to new growth can probably be ruled out. No Name Hill is an island which animals could not reach without swimming; and all four pollen sites are actually *on* settlements inhabited by hunters, not places likely to attract animals. Accidental burning might occur occasionally, but not repeatedly. Access to the lake (Innes *et al.* 2011) is by far the best explanation. Repeated burning of the narrow belt of reed swamp at Star Carr would allow access to the deep-water inlet and the landing of canoes.

### **Birchbark canoes in Lake Flixton**

No unequivocal traces of boats survive from the Early Mesolithic. Discussions are usually limited to the possibilities of dugouts, and skin boats. In this section I will argue that birchbark canoes are more likely than either.

Various dugouts are known from the later Mesolithic. The preferred wood is lime. Mertens (2000, table 7) lists 15 Danish examples, of which all but one are lime. More recently, no fewer than 44 examples have come from the Baltic coast of Germany, of which 43 were lime (Klooss 2015, 181). Lime is relatively soft;

experiments have shown that sections can be split and removed from a trunk quite easily with both stone and antler tools (Moses 1987, Christensen *et al.* 1979). Lime was of course not available in the Preboreal – but birch was.

Birchbark canoes are strongly associated with North America, which may be why they are so little discussed in Europe. The preferred species was the paper birch, *Betula papyrifera*, which could reach a height of 30 metres and have a basal diameter of 75 cm (Adney and Chappelle 1983, 14). A range of other species was also used, however. To make one canoe usually took several sheets of bark, which were sewn together with spruce root and sealed with spruce gum (Durham 1960). An important point is that bark pieces could be stored in a pool to keep them flexible (Adney and Chappelle 1983, 41; Durham 1960, 30). The Great Lakes fur traders' canoes could be 11m or more in length (Adney and Chappelle 1983, 138), and could carry a dozen voyageurs and 4 tons of goods (Labor 1999). Smaller vessels were more common. River canoes were 4.5 – 6 m long, and could carry 4-8 people and their gear. Hunting or pack canoes measured 3.3 – 4.3 m, and could carry up to 4 people and their gear (Cook 2007, Marshall 1986).

Birchbark canoes have a number of virtues. They can access very shallow waterways; they may be poled where the water is not deep enough for paddling, and in the smallest waterways they can be pushed by someone walking alongside (Cook 2007, 30, 62). They are light, and can easily be portaged (carried) by their crew if they have to get round an obstacle (dugout canoes are too heavy to be manhandled by their crews). Lovis and Donahue (2011, fig. 3.10) show a 10 metre canoe being portaged by six men. The smaller canoes could be portaged by one person; some portages could be over long distances. Cook (2007, 47) states that “beaver... were great allies of canoe people” because beaver dams created waterways in brooks otherwise too small to be navigable – and it was easy to slide a canoe over a beaver dam.

It is important to stress that in the recent past birchbark canoes were not restricted to North America, but were common across Eurasia from the Baltic to the Pacific (Luukkanen 2010). They are however rarely discussed in the archaeological literature. A major forthcoming volume (Luukkanen and Fitzhugh in press) will go a long way towards redressing this imbalance. Luukkanen (2010, 190) states that “the birch bark canoe was the ideal boat for the taiga hunter.” As in North America, they were often sewn together from several sections of bark, which would be boiled and smoked to be made pliable. They were light and easy to portage. Larch, elm and spruce bark could be used where birch was unavailable.

Birchbark canoes are probably of considerable antiquity in Eurasia. Westerdahl (1985) notes several reports of finds of undated examples. An archaeological bark canoe comes from Byslätt, Västergötland (southern Sweden). It was found in 1934, and comprised a section of elm bark and four ribs (Humbla and von Post 1937). It survived to a length of 3.5 metres (Eskeröd 1956). The site is on the River Viskan, near several places likely to require portages. The canoe has recently been directly dated to 980-810 cal BC, the Late Bronze Age (Lindberg 2012).

Did birchbark canoes ply Lake Flixton? Direct evidence is lacking, but various things are suggestive. Clark (1954, fig. 77) identified an elongated wooden object as a paddle. Some caution is sometimes expressed about this – Milner *et al.* (2011, 4) describe it as a “possible wooden paddle” – but various other paddles with similar elongated blades are known from European Mesolithic sites (Mertens 2000, table 8; Klooss 2015, 200-18), so there is no reason to question Clark's identification. The size range of Preboreal birch trees is not clear; the horizontal example at Star Carr

was some 43 cm in diameter. A tree this size has a circumference of 135 cm; several sections this wide could be stitched together into a canoe. Clark (1954, 166) records that “numerous tightly wound rolls of birch bark” were found at Star Carr, the largest some 75 x 20 cm. In view of the need to soak bark to keep it pliant (see above) this suggests that sections of bark were deliberately gathered and cached in the lake. This does not prove that it was used for making canoes – it could have been used for roofing shelters, or making containers, and Pitts (1979) suggests that it was a tanning agent used for processing red deer hides. All these are possible, but in view of the ubiquity of birchbark canoes on both sides of the Atlantic in more recent times (see above), canoe construction is perhaps the most likely. Star Carr also produced a resin cake, identified as probably birch resin with an admixture of clay and beeswax (Roberts *et al.* 1998). This would be an ideal sealant for the stitched joins in the bark.

There are numerous other finds of birchbark and birch tar from European Mesolithic sites (Mertens 2000). The most suggestive site is Huseby Klev in Sweden, approximately contemporary to Star Carr. This site was coastal, and the fauna includes many marine species (Hernek and Nordqvist 1995). Boats of some kind are highly likely – and some 90 pieces of birch resin have been found. At least 40 have impressions of wood, cord and withies on one side, and in some cases the impressions can be directly identified as birchbark (Nordqvist 2005, 36). It is likely that these derive from the waterproofing of boats (Hernek and Nordqvist 1995, 127-134).

The case for birchbark canoes in Preboreal Lake Flixton is therefore circumstantial but plausible. The next section explores where boatmen from Star Carr might have travelled to.

### **Star Carr: the upper lake?**

In the previous sections I have argued for the logistic export of meat from the Vale of Pickering; the placing of Star Carr at the best canoe landing site in the Vale; the improvement of the canoe landing area by the construction of the plank platform and the repeated burning of the reed belt; and the likely importance of birchbark canoes.

In this section I examine the wider movements of the hunter-gatherers who visited Lake Flixton. The starting point for this discussion is the central importance of water-based travel and logistic transport. This inevitably directs attention down the canoe artery of the River Derwent, into the lowlying areas of the Vale of York and the Humber estuary (Fig. 23.4).

#### **FIGURE 23.4 HERE**

This focus on the lowlands is the opposite to that normally taken. Clark’s own (1972) reconsideration envisaged movement to the uplands in summer. The North York Moors had not been well studied, and Clark was more interested in the Pennines as a possible summer territory, not least because Radley and Mellars (1964) had identified an industry closely similar to that of Star Carr at Warcock Hill South, a considerable distance to the SW of Star Carr (see Fig. 23.4). Jacobi (1978) also argued for movements to the uplands in the summer, but now the North York Moors played a greater role in the argument, because the industries from Pointed Stone 2 and 3 were very similar to Star Carr. Both Clark (1972) and Jacobi (1978) regarded Star Carr as a winter site. Even after the re-evaluation suggesting spring/summer occupation at Star Carr (Legge and Rowley-Conwy 1988), the uplands have still featured as summer locations (Mellars 1998, Reynier 2004, Donahue and Lovis 2006).



An exception was an effort by the present author (Rowley-Conwy 1995) suggesting that the summer basecamp might be found on the coast, complemented by a winter basecamp at Barry's Island in the Vale of Pickering (see Fig. 23.1 top). This small-scale migration left the upland sites like Pointed Stone and Warcock Hill South unaccounted for. This suggestion has been effectively criticised by Donahue and Lovis (2006) and Uchiyama (2015). Both argue that this scale of movement is simply too small. Remarkably, both propose similar scales of movement, but based on completely different lines of evidence. Donahue and Lovis (2006, 253) suggest likely movements of 50-80 km, based on the ethnography of boreal zone hunter-gatherers in North America. Uchiyama (2015, 9) suggests likely movements of around 60 km, based on the geographical size of typological groupings in Kanto. These criticisms are justified. My original suggestion was based on (a) the hope that the Barry's Island site would turn into a 'winter Star Carr', but this has not happened; and (b) an over-estimation of the importance of the sea shore. The sea stood at about -48 metres at 11,000 cal BP, and -35 metres at 10,000 cal BP (Shennan *et al.* 2012, Ian Shennan pers. comm.), dates which bracket the occupation of Star Carr. Fig. 23.4 shows that these shorelines were relatively straight, without the bays, inlets, sounds and islands that created the high-productivity coastal environments exploited in the Late Mesolithic of Denmark or Portugal. Furthermore, the ridge of moraine between the Vale of Pickering and the sea meant that the coast could not be reached by canoe from the Vale. For these reasons I am happy to see my 1995 effort consigned to the spoil dump of archaeological theories.

The lowlands of the Vale of York and the Humber are rarely discussed at length – the major exception being Uchiyama (2015). The invaluable volumes of the Humber Wetlands Project allow recent wetland areas to be mapped (Fig. 23.4). It must be stressed that some of these wetlands date from the later Holocene, caused by rising sea levels. This goes for those of southern Holderness (Dinnin and Lillie 1995b) and probably the Lincolnshire Marsh (Lillie and Gearey 2001). Elsewhere the situation was different. The meres of Holderness formed in late glacial kettle holes, and remained seasonally or continually flooded until recent times (Dinnin and Lillie 1995a). In the Hull Valley there was considerable Early Holocene fluvial activity and floodplain formation, punctuated by downcutting (Lillie and Gearey 2000). In the main area of the inner Humber and the Vale of York, the retreat of the glacial lobe that filled this area (see Fig. 23.4) left a proglacial lake which had drained by 13,700 BP (Bateman *et al.* 2015). This was followed by extensive areas of late glacial braided channels and aggradation. At some point in the Early Holocene the rivers started to downcut into these sediments. The landscape at this time consisted of migrating river channels and reworked floodplains (Lillie and Weir 1997, Lillie and Gearey 1999). The most useful detailed landscape survey is that by Halkon and Innes (2005), who examined the Foulness Valley (see Fig. 23.4). The early postglacial saw extensive areas of reedswamp wetlands and freshwater systems along the course of the current river; Early Mesolithic deposits comprise a complex mix of peat, estuarine clays, and alluvium (Halkon and Innes 2005, fig. 4). They stress the "...complexity of the riverine wetland vegetation units that came into being in this region under the influences of sea-level elevation, alluviation, and water-table fluctuations" (op. cit., 231), adding that "it seems probable that the wetland environments of the Foulness valley would have provided a centre of resource availability and a focus for human activity" (op. cit., 233). Mesolithic flint scatters occur on natural sandy hills.

The inner Humber/Vale of York area was thus probably characterised by incising river courses cutting through areas of sandy elevations, shallow lakes, and

poorly drained wetlands. These would probably be unstable and dynamic as the drainage systems sorted themselves out. This might have continued beyond the areas examined by the Humber Wetlands Project – much wider areas are below 25 metres in altitude (Fig. 23.4), approximately the level of the surface of Lake Flixton, and would also probably have had areas of seasonal and permanent wetlands. A major study of the Swale and Ure rivers at the upper end of the Vale of York terms these lowlying areas the ‘washlands’, characterised in the early postglacial by numerous waterways, wetlands, and areas of open water (Bridgland *et al.* 2011).

This landscape would be difficult to traverse on foot, but birchbark canoes would provide the ideal means of exploiting and travelling through it, by virtue of their ability to navigate the smallest streams, and being lightweight and easy to portage (see above). The productivity of such wetlands probably made this the main regional centre of Early Mesolithic habitation. Forays out from here could go up the Pennine rivers to sites like Warcock Hill South, or Malham Tarn A (Donahue and Lovis 2006). Sites like Pointed Stone on the North York Moors were accessible via the western part of the Vale of Pickering. Holderness was probably also part of the system – 13 bone points have been recovered from around Brandesburton. There are some differences between these and the large number from Star Carr (Davis-King 1980); none has apparently been directly dated but they are acknowledged to be Early Mesolithic. And forays up the Derwent would bring people to the uppermost lake in this system: Lake Flixton. Ames (2002) states that a one-way journey of 50 km would be easily achievable in one day by canoe. Along the more winding channels that probably characterised the Preboreal rivers, this is about the distance from Lake Flixton to the Kirkham Gorge, which would probably have required a portage; this might have been the site of an overnight camp.

Various aspects of the Lake Flixton archaeological record fall into place when viewed from this perspective. Early Mesolithic people round the lake used varying quantities of two different types of flint: good quality white flint from the Yorkshire Wolds, and poorer quality material from glacial till. It is assumed that the till flint came from the sea shore because the nodules have pitted cortex (Conneller and Schadla-Hall 2003, 88). However, it seems equally likely that such flint could have come from the glacial till in the Vale of York, the pitting occurring as the incising river channels cut through the underlying glacial moraine. Three caches of flint nodules have been found (plotted in Fig. 23.1 top). These comprise 12, 9, and 5 nodules respectively, and were found tightly grouped (Conneller and Schadla-Hall 2003, fig. 11). These caches would be quite heavy, and quite burdensome to someone on foot – which would be the only way to access the sea shore. But they would be no effort to transport in a canoe travelling through eroding till in the Vale of York. Binford (1979) describes the caching of materials by hunter-gatherers as common; raw materials are usually obtained via “embedded procurement” while carrying out other subsistence tasks, direct trips for obtaining them being rare. This may be why the Vale of Pickering flint caches are of the poorer quality till flint, not the better Wolds material: trips to Lake Flixton passed through areas of till, not over the Wolds.

## Conclusion

In the scenario put forward here, Star Carr formed the logistic and industrial hub about which the activities in the Vale of Pickering were articulated with the larger Vale of York/Humber settlement system (see also Uchiyama 2015). The site lay where the river met the lake, and had easy access to open water, which was maintained through



the inhabitants laying planks and burning the reeds. Star Carr was a hunting camp, where meat was prepared for onward transport. It was also probably a hunting stand, offering views over much of Lake Flixton. But it was also more than this (Elliott and Milner 2010, 82). Many other activities were carried on. Hides would have been prepared for onward transport (Pitts 1979). Birchbark canoes might have been constructed or repaired. Red deer would not have been carrying antlers in the late spring and summer, so the numerous antlers attached to their pedicels found at Star Carr must have been imported – facilitated by canoe travel. Blanks were produced for point manufacture, but there is no manufacturing debris from actual point manufacture (Elliott and Milner 2010). Were the blanks taken away, perhaps to the upland sites occupied later in the summer, where the points were made and used? Broken points might then be returned to Star Carr and cached in the lake for future reworking. Roe deer would have been carrying antlers during the summer, but most roe killed at Star Carr were juvenile, while the antlers come from adult males and were far more numerous than the other roe deer remains. These too were probably imported as piercing tools of some kind – they fit nicely into the hand and would be useful for a variety of tasks (Legge and Rowley-Conwy 1988). And what were the abraded aurochs distal metapodials (op. cit., fig. 17) used for?

The settlement system proposed here existed only through the Preboreal. Hazel began immigrating at the end of the Star Carr occupation (Dark 1998a, 142). Although hazel would present its own opportunities, the closing of the forest canopy would have reduced grazing potential beneath it. At the same time Lake Flixton was shrinking and the reed belt widening (Mellars 1998, 230-31). This may have been a common pattern across the wider area – Halkon and Innes (2005, 234) note that in the Foulness Valley the close link between Early Mesolithic human activity and the productive aquatic landscapes decreased markedly at this time. The rapid decline of birch at the same time would have reduced the availability of material for building canoes. Elm did not become important until a millennium later, so there may have been a lengthy lacuna in canoe building at this point in the Mesolithic. Hide boats could have been made, but these need drying out every day or two and do not match the performance and utility of birchbark canoes. After Star Carr, Mesolithic Britain was a very different place so far as its Mesolithic inhabitants were concerned.

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## Figure captions

Figure 23.1. Top: outline map of Lake Flixton in the Preboreal. Lake outline and sites redrawn from Taylor (2011, fig. 3). Sites showing evidence of clearance by burning from Dark (1998a) and Cummins (2000). Flint cache sites from Conneller and Schadla-Hall (2003). Bottom: contour map of the western end of Lake Flixton, showing the likely extent of the reedswamp and site locations. Contours from Cloutman (1988a, figs. 3 and 4); the 24.5 m line is taken as the shoreline, the 23 m line the edge of open water (following Cloutman 1988a, 17), except in the northern part where the reedswamp was wider; the dotted line follows Schadla-Hall (in Spratt 1993, fig. 26). The inner edge of the reedswamp at Seamer Carr would have merged into fen carr (Cloutman 1988b, fig. 7).

Figure 23.2. Top: Skeletal element frequency of the four main species at Star Carr, showing the rarity of elements comprising the haunch (redrawn from Legge and Rowley-Conwy 1988, fig. 40). Bottom: Elements present at the aurochs butchery location at Seamer Carr site B (from Uchiyama *et al.* in press).

Figure 23.3. Canoeist's-eye view of a dense reed swamp when approaching from the lake. The lily zone next to the reeds marks the transition to deeper water (photo PR-C).

Figure 23.4. Map of northeastern England. Maximum ice advance from Catt (1990, fig. 2.3). Recent wetlands amalgamated and redrawn from Dinnin and Lillie (1995, fig. 5.1), Lillie and Gearey (1999, fig. 5.1; 2000, fig. 5.1; 2001, fig. 5.1, Lillie and Parkes (1998, fig. 5.1) and Lillie and Weir (1997, fig. 6.1). Lower channels of the Trent, Idle and Don are pre-drainage (from Van de Noort and Davies 1993, fig. 2.8). Old course of the Derwent from Schadla-Hall and Cloutman 1985, fig. 6.1). The sea level was at -48m in 11,000 cal BP, and at -35m in 10,000 cal BP (Shennan *et al.* 2012, Ian Shennan pers. comm.); these dates bracket the occupation of Star Carr.









